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Patentanmeldung Nr. | Patent application No. | Demande de brevet n°

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Im Auftrag

For the President of the European Patent Office

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Transmission of random access bursts with at least one message part

The present invention relates to devices for transmitting and receiving data in a digital telecommunication system, as e. g. a base station or a mobile terminal, and to a method for transmitting and receiving random access bursts in a random access channel of a digital telecommunication system.

The telecommunication system is a system, in which data are communicated between one or more base stations and one or more mobile stations. Thereby, the communication area is divided in cells, in which one base station communicates with one or more mobile stations. The data transmission from a mobile station to a base station is called uplink and the data transmission from a base station to one or more mobile stations is called downlink. For the uplink and the downlink, several transmission channels for the transmission of control and user data are available, e. g. a broadcast control channel, a synchronization channel, a user data channel, a random access channel etc. In some telecommunication systems, a communication also between mobile terminals is possible.

A communication device of the telecommunication system, as e. g. a base station or a mobile terminal, may not have an existing dedicated connection to another communication device of the telecommunication system, but may wish to transmit control or user data. An example of such data may be an initial setup message to be sent from a mobile terminal to a base station to establish a first signaling connection. Usually, the random access channel is used for this purpose since it does not require prior negotiation, whereby the random access channel is accessed randomly by the communication device requiring a connection. Thereby, the random access data transmitted from a mobile station to a base terminal can e. g. contain a request, if the base station has sufficient resources available to build up the required connection or to transfer user data.

Usually, a random access burst consists of a preamble part and a message part as shown in figure 1. The preamble part has a length of 1 ms, and the message part has a length of 10 ms, whereby a time delay of 0,25 ms is present between the preamble part and the message part.

The random access channel used for the transmission of the random access bursts comprises or consists of succeedingly or periodically provided random access time windows, in which several random access slots are available. The different random access slots are randomly chosen by a communication device for the transmission of random access data. E. g. in a currently proposed wide band direct sequence CDMA (WCDMA) system, the random access channel is based upon an initial preamble spreading code, which differentiates between one cell and another cell. The spreading code for each cell needs to be planned to ensure that neighboring cells do not use the same spreading code. Within the preamble part of each random access burst, is provided the preamble signature, which is one of 16 separate codes available for use within that cell. These 16 separate preamble signature codes can be seen as separate slots, as indicated in the scheme shown in figure 2. One of these spreading codes is chosen randomly by a communication device for the transmission of the preamble part of the random access burst.

Beforehand, the base station or the respective cell controlling unit signals, e. g. over the broadcast control channel, which codes are available in each cell. Additionally, within the time frame for the transmission of a random access burst (10 ms) are provided a number of time offsets, each of 1.25 ms allowing a further 8 variations. In other words, in each time frame a random access time window is provided, a scheme of which is shown in figure 2 and which comprises a plurality of random access slots for transmitting random access data. The random access time window thereby extends over a time frame of 10 ms, so that 128 different random access slots (16 separate preamble codes and 8 time offsets) are provided within one random access time windows.

The preamble signature, i. e. the signature code of the preamble part of a random access burst determines the spreading code for the message part of this random access burst. As shown schematically in figure 3, the preamble signature points to a place in the spreading code tree available for the message part. The message part is then transmitted with this spreading code, e. g. with a spreading factor 16 or 32. Thus, the possibility of collisions between message parts simultaneously transmitted from different communication devices is significantly reduced.

In figure 4, a sequence of exchanged data between a first communication device, i. e. a user equipment or mobile station, and a second communication device, i. e. a cell controller or a base station of the telecommunication system is schematically shown. The mobile terminal attempting to transmit random access data in the random access channel firstly transmits the preamble part to the base station. The preamble part, as explained above has an allocated unique combination of a preamble signature and a time

offset randomly chosen from the available values. Thus, a collision of two preamble parts simultaneously sent from two different mobile terminals to a receiving base station only occurs if the two preamble parts have the same preamble signature and the same time offset. A base station properly receiving a preamble part transmits an acquisition response, e. g. on a downlink common channel, back to the mobile terminal. Then, the mobile terminal transmits the corresponding message part to the base station. In case that the base station does not send an acquisition response, the message part is not sent. The message part contains the random access data. Since the length of the message part is fixed, e. g. 10 ms, the amount of data to be transmitted within one message part is restricted. However, in many cases the size of the message part of the random access burst will be insufficient, so that the random access data to be transmitted have to be segmented over a number of different random access bursts. The transmission of a number of random access bursts is problematic since the transmission is contention-based and there is an increased possibility of collisions when a number of random access bursts is transmitted sequentially. Further, this leads to an undeterminable duration for the random access data transmission. Further, for each random access data segment, a new random access burst has to be formed and to be transmitted. Further, each preamble part has to be successfully received in a receiving device and answered by a positive acquisition response so that the corresponding message part can be transmitted. Then, the random access data of the different message parts transmitted within the different random access bursts have to be reassembled in the receiving device into the complete data set.

The object of the present invention is therefore to provide devices for transmitting and receiving data in a digital telecommunication system and a method for transmitting and receiving random access bursts in a random access channel of a digital telecommunication system, which enable the transmission of a larger amount of random access data in a simple and efficient way.

This object is achieved by a device for transmitting and receiving data in a digital telecommunication system, in which a random access channel for transmitting random access bursts is provided, according to claim 1, which comprises a generating means for generating a random access burst comprising a preamble part for acquiring a part of said random access channel and at least one message part for transmitting data in said acquired part of said random access channel, the number of message parts depending on an amount of data to be transmitted in the message parts, whereby in case that two or more message parts are generated, each preceding message part comprises a continuation indicator indicating a succeeding message part, and transmitting means for

transmitting said random access burst generated by said generating means. This communication device is e. g. a mobile station of the telecommunication system.

The above object is further achieved by a device for transmitting and receiving data in a digital telecommunication system, in which a random access channel for transmitting random access bursts is provided, according to claim 8, which comprises receiving means for receiving a random access burst comprising a preamble part for acquiring a part of said random access channel and at least one message part for transmitting data in said acquired part of said random access channel, the number of message parts depending on an amount of data to be transmitted in the message parts, whereby in case that two or more message parts are generated, each preceding message part comprises a continuation indicator indicating a succeeding message part, and detecting means for detecting a continuation indicator in a received message part and reserving a further part of said random access channel for receiving a succeeding message part.

This communication device is e. g. a base station of the telecommunication system.

The above object is further achieved by a method for transmitting and receiving random access bursts in a random access channel of a digital telecommunication system according to claim 15, comprising the steps of generating a random access burst comprising a preamble part for acquiring a part of said random access channel and at least one message part for transmitting data in said acquired part of said random access channel, the number of message parts depending on an amount of data to be transmitted in the message parts, whereby in case that two or more message parts are generated, each preceding message part comprises a continuation indicator indicating a succeeding message part, transmitting said generated random access burst, and detecting a continuation indicator in a transmitted message part and reserving a further part of said random access channel for a succeeding message part.

Thus, the communication devices and the method according to the present invention enable the transmission of large amounts of random access data in a random access burst by providing several message parts within one random access burst. After the transmission of a preamble part and a corresponding acquisition response from a receiving communication device, several message parts can be transmitted without the necessity to transmit a preamble part for each transmitted message part. Each preceding message part contains an indicator which informs the receiving communication device that a further message part is to be expected. The receiving communication device, e. g. a base station, then reserves the corresponding succeeding time period corresponding to the length of a message part, so that an undisturbed reception is assured. Another

communication device attempting to access the random access channel will not receive an acquisition indicator from the receiving communication device during the reserved time period. Thus, once access to the random access is granted, a transmitting communication device can transmit a large amount of random access data within a plurality of message parts without the risk that the access to the random access channel is refused due to contention. Advantageously, the message parts all have the same length so that simple transmitter and receiver structures can be realized.

Advantageously, the continuation indicator is located at the end of a respective message part. This enables to maintain the normal structure of the message parts, since the continuation indicator is just added to the end of the message part. Further alternatively, the continuation indicator consists of a single bit in the respective message part. Hereby, a receiving communication device can decide in a simple way if a further message part will follow. Further advantageously, the last message part of several message parts comprises an end indicator indicating the message part to be the last message part. Thereby, a receiving communication device is able to decide that no further message parts are going to follow and that the reservation is no longer necessary. Thereby, the end indicator can be located at the end of the last message part. Further advantageously, the continuation indicator as well as the end indicator consist of a single bit and have different bit values. In this way, very simple structures on the transmitter side and on the receiver side are enabled, since only a single bit has to be added to the message part, which can be easily detected on the receiver side.

The proposed communication devices and the proposed method of the present invention are particularly advantageous, since they support the use of a random access burst having a standard length, i.e. the proposed scheme is backward compatible. In the case that the continuation indicator is the last bit of the message part and this bit is set to zero, the message part corresponds to a standard length message part.

Further advantageously the two or more message parts are continuously, i.e. directly one after the other, transmitted and received. Hereby, a very efficient transmission of message parts can be achieved.

The present invention is explained in more detail in the following description by means of preferred embodiments relating to the enclosed drawings, in which

figure 1 shows the structure of a known random access burst,

figure 2 shows a scheme of available random access slots defined by a respective combination of a preamble signature and a time offset,

figure 3 shows the allocation of a scrambling code to a message part on the basis of the signature code of the preamble part,

figure 4 shows the acquisition scheme of the random access channel,

figure 5 shows the structure of several message parts of a random access burst according to the present invention,

figure 6 shows a communication device generating and transmitting random access bursts according to the present invention, and

figure 7 shows a communication device receiving random access bursts according to the present invention.

Figure 5 shows the structure of several succeeding message parts of a random access burst according to the present invention. The random access burst of the present invention also comprises a preamble part preceding the message parts as explained in relation to figures 1 to 4. In the example of figure 5, the continuation indicator is located at the end of a respective message part. The first message part and the second message part respectively comprise an continuation indicator at the end of their data. The third and last message part comprises an end indicator indicating the end of the random access data transmitted in the random access burst. The continuation indicators of the first and the second message part may e. g. have the value "1", and the end indicator of the third message part can have the value "0". Thus, a communication device receiving the first message part receives the bit value "1" at the end of the first message part and the second message part and therefore knows that a further message part is being transmitted. The receiving communication device reserves the corresponding part of a random access channel, i. e. the time period necessary for the transmission of the message part, so that a proper reception of the following message part is assured. As soon as the receiving communication device receives the bit value "0", e. g. at the end of the third message part, it knows that no further message parts are being transmitted, releases the reservation and provides the remaining or next part of the random access channel for contention-based random access attempts.

Figure 6 shows the general structure of a communication device 1 for transmitting and receiving data in a digital telecommunication system according to the present invention.

The communication device 1 can e. g. be a mobile terminal of the telecommunication system. The communication device 1 comprises a generating means 3 for generating a random access burst according to the present invention, comprising a preamble part and at least one message part, whereby the number of message part depends on the amount of random access data to be transmitted. In case that two or more message parts are generated, each preceding message part comprises a continuation indicator indicating, that a further message part is succeeding. Thereby, the continuation indicator can be a single bit located at the end of a preceding message part, as shown in figure 5.

Further, the communication device 1 comprises transmitting means 4 for transmitting the random access burst generated by the generating means 3. The transmitting means 4 can e. g. be a RF means, which transmits the random access bursts by means of an antenna 2 of the communication device 1. Further, the communication device 1 comprises receiving means 5 for receiving data from other communication devices of the telecommunication system, e. g. for receiving an acquisition response from a base station in response of a transmitted preamble part for acquiring access to a random access channel to transmit random access data, as e. g. explained above in relation to figure 4.

It is to be noted, that a communication device 1 shown in figure 6 further comprises all necessary elements for transmitting and receiving data in a telecommunication system, as e. g. encoders, decoders, modulators, demodulators etc. However, figure 6 only shows the elements important for and in relation to the present invention. The same is true for the communication device 6 shown in figure 7, which might be a base station of the telecommunication system.

Figure 7 shows the general structure of the communication device 6, which is adapted to receive random access bursts of the present invention as e. g. transmitted by the communication device 1 shown in figure 6. The communication device 6 comprises an antenna 7 for receiving and transmitting data in the telecommunication system and a receiving means 8 for receiving a random access burst comprising a preamble part for acquiring a part of the random access channel and at least one message part for transmitting data in the acquired part of the random access channel. Further, the communication device 6 comprises detecting means 9 for detecting a continuation indicator in a received message part and reserving a further part of said random access channel for receiving and succeeding message part. Thus, if the receiving means 8 receives e. g. the message part 1 shown in figure 5, it detects the continuation indicator bit "1" at the end of the message part and reserves a further time period corresponding to the length of a further message part. Then, the receiving means 8 receives the second

message part and detects a further continuation indicator bit "1" at the end of the second message part to reserve another part of the random access channel corresponding to the length of a further message part. Upon reception of the third message part by the receiving means 8, the detecting means 9 detects the end indicator bit "0" at the end of the third message part and recognizes that no further message parts are to be expected. Therefore, no further parts of the random access channel are reserved by the communication device 6. Since no further reservation is present, the random access channel can now be accessed again by different communication devices on a contention basis.

As stated above, the communication device 6 further comprises a transmission means 10 for transmitting data in the telecommunication system, as e. g. an acquisition response answering a received preamble part. A further communication device 6 comprises modulators, demodulators, encoders, decoders and so on necessary for operating as a communication device in the digital telecommunication system.

In addition to the features of the message parts explained in relation to figure 5, the random access bursts generated and transmitted by the communication device 1 and received by the communication device 6 have the same characteristics as the random access bursts explained in relation to figures 1, 2, 3 and 4. E. g., the preamble parts of the random access bursts generated by the generating means 3 of the communication device 1 correspond identically to the preamble part of the random access burst explained in relation to figure 1. Further, the relation between the preamble signature and the spreading code of the message part of a random access burst explained in relation to figure 3 is also true for the random access bursts of the present invention. Further, the random access channel acquisition scheme explained in relation to figure 4 is also performed by the communication device 1 shown in figure 6 and the communication device 6 shown in figure 7.

The present invention provides a scheme for transmitting and receiving random access bursts in the digital telecommunication system, in which a higher amount of random access data can be transmitted within one random access burst. The main advantages are the increased length of the message data transmission, whilst the amount of a contention-based access is reduced, since the preamble part is only transmitted once even for several message parts. Further, the reduction of the contention-based access means that interference is significantly reduced. Further, the present scheme is compatible with the transmission and reception of singular random access bursts, in which only one preamble part and one message part are contained.

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Claims

1. Device (1) for transmitting and receiving data in a digital telecommunication system, in which a random access channel for transmitting random access bursts is provided, with

generating means (3) for generating a random access burst comprising a preamble part for acquiring a part of said random access channel and at least one message part for transmitting data in said acquired part of said random access channel, the number of message parts depending on an amount of data to be transmitted in the message parts, whereby in case that two or more message parts are generated, each preceding message part comprises a continuation indicator indicating a succeeding message part, and

transmitting means (4) for transmitting said random access burst generated by said generating means.

2. Device (1) for transmitting and receiving data in a digital telecommunication system according to claim 1,
characterized in,
that said continuation indicator is located at the end of a respective message part.

3. Device (1) for transmitting and receiving data in a digital telecommunication system according to claim 1 or 2,
characterized in,
that said continuation indicator consists of a single bit in the respective message part.

4. Device (1) for transmitting and receiving data in a digital telecommunication system according to claim 1, 2 or 3,
characterized in,
that the last of two or more message parts comprises an end indicator indicating the message part to be the last message part.

5. Device for transmitting and receiving data in a digital telecommunication system according to claim 4,
characterized in,
that said end indicator is located at the end of a the last message part.

6. Device (1) for transmitting and receiving data in a digital telecommunication system according to claim 4 or 5, if related back to claim 3,
characterized in,
that said end indicator consist of a single bit in the last message part having a bit value different from the bit value of the continuation indicator.

7. Device (1) for transmitting and receiving data in a digital telecommunication system according to one of the claims 1 to 6,
characterized in,
that said transmitting means continuously transmits said two or more message parts.

8. Device (6) for transmitting and receiving data in a digital telecommunication system, in which a random access channel for transmitting random access bursts is provided, with

receiving means (8) for receiving a random access burst comprising a preamble part for acquiring a part of said random access channel and at least one message part for transmitting data in said acquired part of said random access channel, the number of message parts depending on an amount of data to be transmitted in the message parts, whereby in case that two or more message parts are generated, each preceding message part comprises a continuation indicator indicating a succeeding message part, and

detecting means (9) for detecting a continuation indicator in a received message part and reserving a further part of said random access channel for receiving a succeeding message part.

9. Device (6) for transmitting and receiving data in a digital telecommunication system according to claim 8,

characterized in,

that said detecting means (9) detects said continuation indicator at the end of a respective message part.

10. Device (6) for transmitting and receiving data in a digital telecommunication system according to claim 8 or 9,

characterized in,

that said detecting means (9) detects said continuation indicator as a single bit in the respective message part.

11. Device (6) for transmitting and receiving data in a digital telecommunication system according to claim 8, 9 or 10,

characterized in,

that the last of two or more message parts comprises an end indicator indicating the message part to be the last message part, whereby said detecting means detects said end indicator and terminates the reservation of the random access channel.

12. Device (6) for transmitting and receiving data in a digital telecommunication system according to claim 11,

characterized in,

that said end indicator is located at the end of a the last message part.

13. Device (6) for transmitting and receiving data in a digital telecommunication system according to claim 11 or 12, if related back to claim 10,

characterized in,

that said detecting means (9) detects said end indicator as a single bit in the last message part having a bit value different from the bit value of the continuation indicator.

14. Device for transmitting and receiving data in a digital telecommunication system according to one of the claims 8 to 13,

characterized in,

that said detecting means, upon detecting a continuation indicator in a received message part, reserves a the next part of said random access channel after the preceding message part so that a succeeding message part is continuously received.

15. Method for transmitting and receiving random access bursts in a random access channel of a digital telecommunication system, with the steps of

generating a random access burst comprising a preamble part for acquiring a part of said random access channel and at least one message part for transmitting data in said acquired part of said random access channel, the number of message parts depending on an amount of data to be transmitted in the message parts, whereby in case that two or more message parts are generated, each preceding message part comprises a continuation indicator indicating a succeeding message part,

transmitting said generated random access burst, and

detecting a continuation indicator in a transmitted message part and reserving a further part of said random access channel for a succeeding message part.

16. Method for transmitting and receiving random access bursts according to claim 15, **characterized in,**

that said continuation indicator is located at the end of a respective message part.

17. Method for transmitting and receiving random access bursts according to claim 15 or 16,

characterized in,

that said continuation indicator consists of a single bit in the respective message part.

18. Method for transmitting and receiving random access bursts according to claim 15, 16 or 17,

characterized in,

that the last of two or more message parts comprises an end indicator indicating the message part to be the last message part.

19. Method for transmitting and receiving random access bursts according to claim 18,

characterized in,

that said end indicator is located at the end of a the last message part.

20. Method for transmitting and receiving random access bursts according to claim 18 or 19, if related back to claim 17,

characterized in,

that said end indicator consist of a single bit in the last message part having a bit value different from the bit value of the continuation indicator.

21. Method for transmitting and receiving random access bursts according to one of the claims 15 to 20,

characterized in,

that said two or more message parts are continuously transmitted.

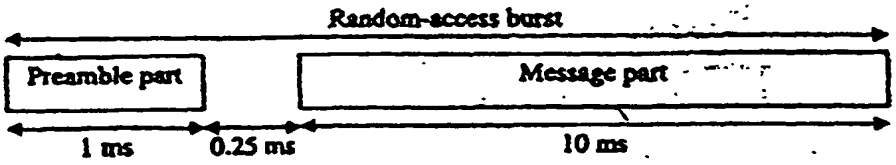

Fig 1

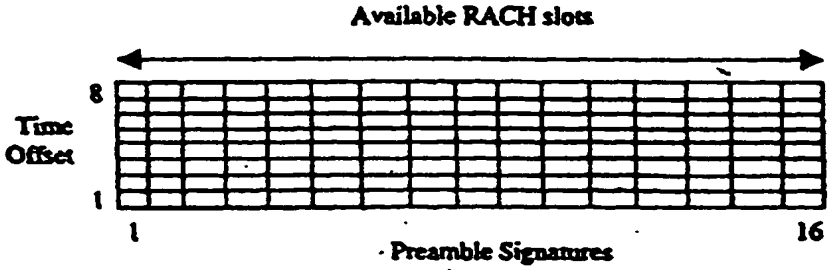

Fig 2

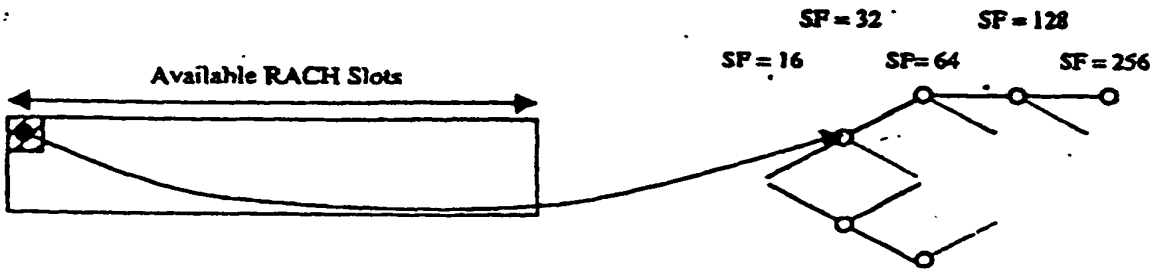

Fig 3

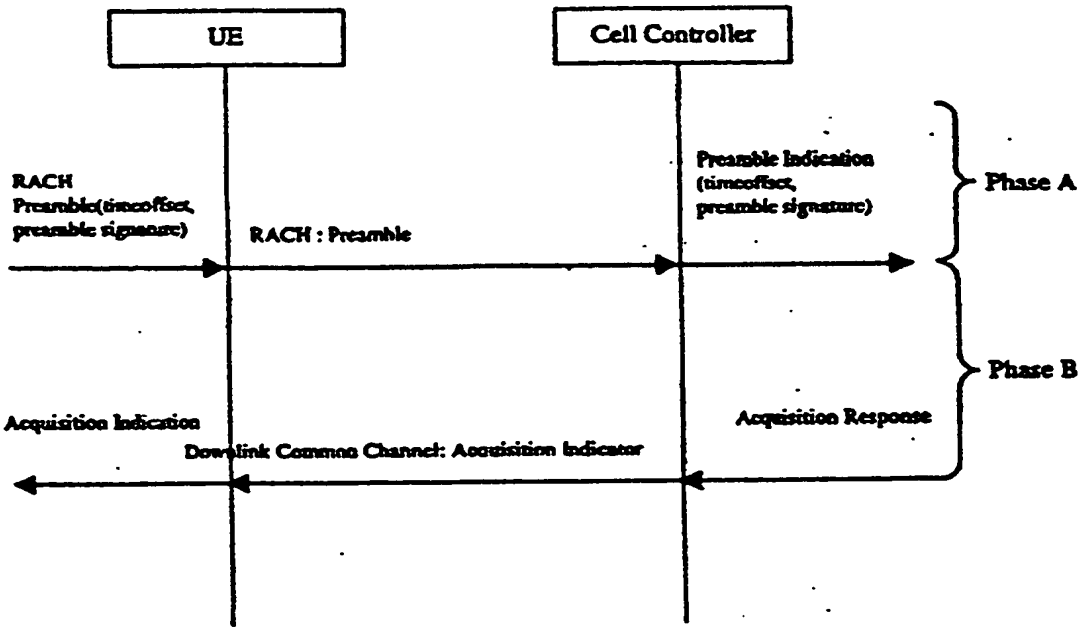

Fig 4

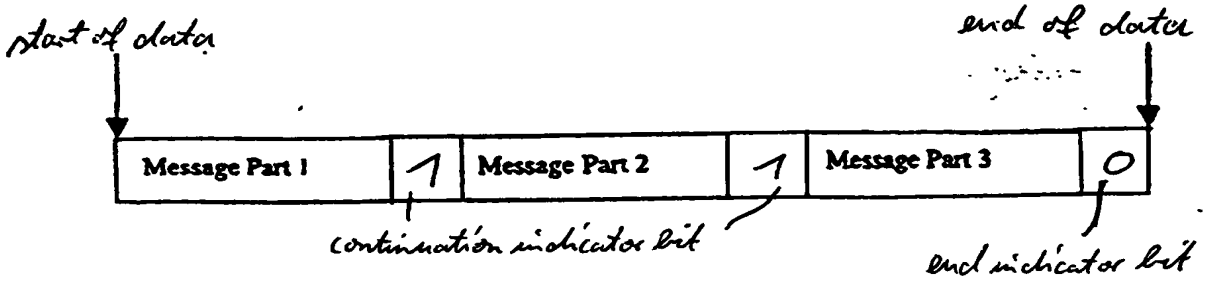

Fig 5

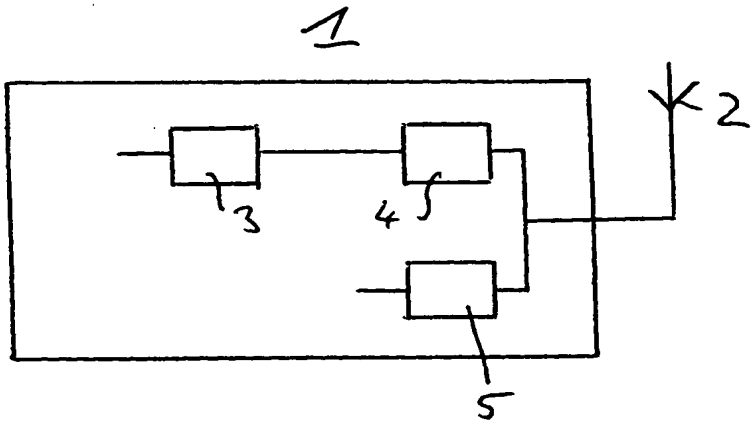

Fig 6

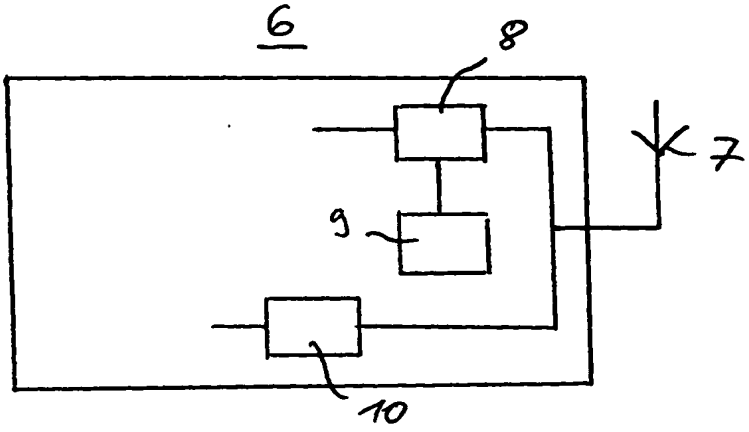

Fig 7

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Abstract

The present invention proposes communication devices (1, 6) and a method for transmitting and receiving random access bursts in a random access channel of a digital telecommunication system. Thereby, a random access burst comprising a preamble part for acquiring a part of said random access channel and at least one message part for transmitting data in said acquired part of the random access channel is generated, whereby the number of message parts depends on an amount of data to be transmitted in the message parts. In case that two or more message parts are generated, each preceding message part comprises a continuation indicator indicating a succeeding message part. After transmission of such a random access burst, the continuation indicator is detected and a further part of the random access channel is reserved for the succeeding message part. The present invention has the advantage that a higher amount of random access data can be transmitted within one random access burst in a simple way without enhancing the contention-based access to the random access channel.

(Figure 5)